

CLAIMS:

1. An extruded thermoplastic polymer foam comprising a polymer composition, wherein at least 70 weight-percent of the polymer composition is one or more alkenyl aromatic polymer that contains less than 20 wt% covalently bonded halogens based on alkenyl-aromatic polymer weight and that has a polydispersity of less than 2.5 and wherein both the polymer composition and the one or more alkenyl aromatic polymer have a water solubility greater than 0.09 moles per kilogram (mol/kg) and 2.2 mol/kg or less at conditions of 130 degrees Celsius and 101 kilopascals pressure; the thermoplastic polymer foam characterized by having:

- (a) a density of 64 kilograms per cubic meter or less;
- (b) a thermal conductivity according to ASTM method C518-04 of 32 milliWatt per meter-Kelvin or less after at least 180 days aging;
- (c) one or more primary surface and a width, wherein 98% or more of any 200 square-centimeter portion of any primary surface of the foam that is centered on the foam's primary surface and extending to 80% of the foam's width free of defects;
- (d) less than 30% open cell content according to ASTM method D6226-05; and
- (e) a chlorine-free fluorinated blowing agent present at a concentration of 0.4 moles or more per kilogram of extruded thermoplastic polymer foam.

2. The foam of Claim 1, wherein the foam is free of chlorinated blowing agents.

3. The foam of Claim 1, wherein the alkenyl-aromatic polymer includes a styrene-acrylonitrile copolymer and, optionally, another alkenyl-aromatic polymer or copolymer.

4. The foam of Claim 1, wherein the alkenyl-aromatic polymer consists of a blend of one or more styrene-acrylonitrile copolymer and polystyrene.

5. The foam of Claim 1, wherein the chlorine-free fluorinated blowing agent comprises one or more blowing agent selected from 1,1,1,2-tetrafluoroethane and 1,1-difluoroethane.

6. The foam of Claim 1, wherein the chlorine-free fluorinated blowing agent is one or more blowing agent selected from 1,1,1,2-tetrafluoroethane and 1,1-difluoroethane.

7. The foam of Claim 1, wherein the chlorine-free fluorinated blowing agent is present at a concentration of 0.4 moles or more per kilogram of foam.

8. The foam of Claim 1, further comprising an additive selected from a group consisting of insoluble lubricants and nucleating agents having an affinity for ions.

9. The foam of claim 8, wherein the additive is selected from a group consisting of talc, oxidized polyethylene and boron nitride.

10. The foam of Claim 1, wherein the polymer composition has a polydispersity of less than 2.5.

11. A process for preparing extruded thermoplastic polymer foam comprising:

(a) providing a foamable polymer composition in an extruder, the foamable polymer composition comprising:

i. a polymer composition, wherein at least 70 weight-percent of the polymer composition is one or more alkenyl-aromatic polymer that contains less than 20 wt% covalently bonded halogens based on alkenyl-aromatic polymer

weight and that has a polydispersity of less than 2.5 and wherein both the polymer composition and the one or more non-halogenated alkenyl-aromatic polymer have a water solubility greater than 0.09 moles per kilogram (mol/kg) and 2.2 mol/kg or less at conditions of 130 degrees Celsius and 101 kilopascals pressure; ; and

ii. 0.9-2 mol/kg of a blowing agent composition containing:

1. one or more chlorine-free fluorinated blowing agent at a concentration of 0.4 mol/kg or more;

2. water at a concentration of at least 0.15 mol/kg and up to the water solubility of the polymer composition or the balance of blowing agent beyond chlorine-free fluorinated blowing agent, whichever is less; and

3. one or more additional halogen-free blowing agent other than water accounting for any remaining blowing agent concentration;

wherein mol/kg values are moles per kilogram of alkenyl-aromatic polymer; and

(b) expanding the foamable polymer composition into a thermoplastic polymer foam having at least one primary surface, a density of 64 kilograms per cubic meter or less, a thermal conductivity of 32 milliWatt per meter-Kelvin or less after at least 180 days aging

20. The process of Claim 19, wherein the additional additive is selected from a group consisting of talc, oxidized polyethylene and boron nitride.

21. The process of Claim 11, wherein the polymer  
5 composition has a polydispersity of less than 2.5.

22. A process for using the polymer foam of Claim 1 comprising a step of placing the polymer foam between two areas.